SOME CONODONTS OF THE UPPER RICHMOND OF OHIO, AND THEIR APPLICATION IN DETERMINING STRATIGRAPHIC POSITION

A thesis presented in partial fulfillment of the requirements for the degree of Bachelor of Science in the College of Mathematics and Physical Sciences of the Ohio State University

By

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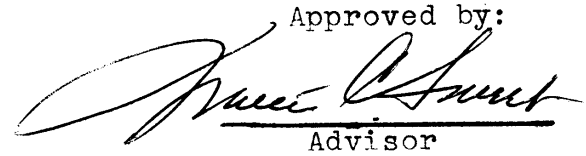

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INTRODUCTION

Sections of the uppermost Upper Ordovician (Richmondian) are scarce in Ohio, as a result of widespread cover by glacial deposits. Sections that are accessible are mostly of limited vertical extent, and are also rather far apart. Mapping, as well as determination of stratigraphic position is difficult because of the large distances between successive outcrops. Over such distances, mappable units may be lost due to erosion, facies change, or concealment by subsequent deposits. In obtaining good stratigraphic control, conodonts have been shown to be well adapted, owing to their rapid evolution and their nearly facies independent occurrence. This report will concern itself with the use of conodonts in determining the stratigraphic position, and correlation of a section of Richmondian strata in Montgomery County, Ohio.

METHODS

In this report, multielement taxonomy has been employed in the identification of conodont species (Bergström and Sweet, 1966; Kohut, 1968). Conodont elements were collected from limestone samples weighing approximately 1000 grams. These samples were taken at five foot intervals as often as possible, and were digested in a fifteen percent Acetic acid solution. The insoluble residue was then sifted through a 100-mesh screen, and only that fraction remaining on the screen was retained. Fractions of this residue not bearing conodonts

were eliminated by separation employing heavy liquids, followed by use of the Frantz Isodynamic Separator. The number of conodonts collected was very small, about 21 per kilogram. All were amber in color.

ACKNOWLEDGMENTS

The writer is indebted to Dr. W. C. Sweet, professor of geology at The Ohio State University. His instruction and the materials that he made available are much appreciated.

LOCATION AND LITHOLOGY OF SECTION

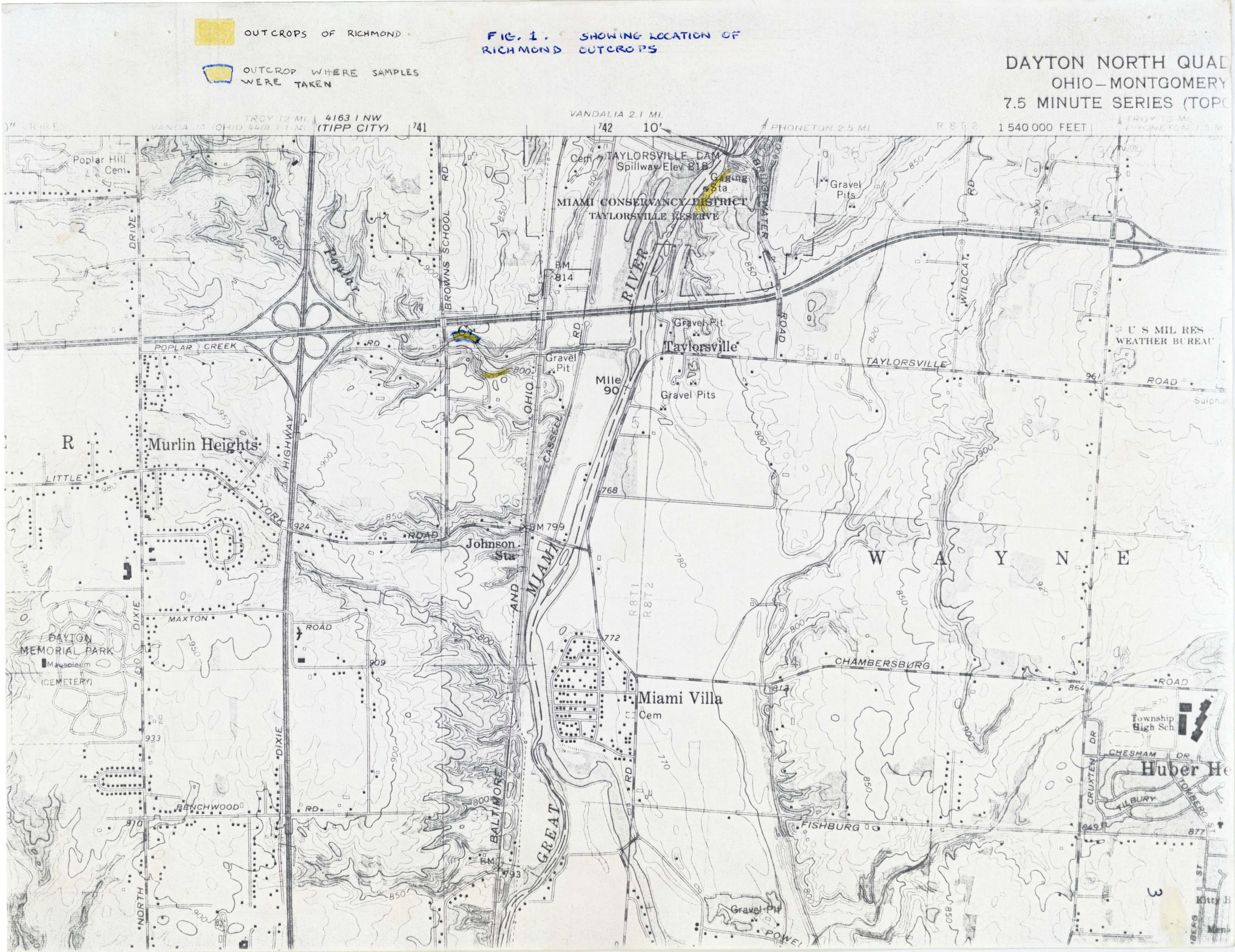
The section with which this report is concerned is in northwestern Montgomery County, Ohio, just north of Poplar Creek Road, southeast of Vandalia (Fig. 1). The exact stratigraphic position of the strata in this section was unknown, other than that the exposure is less, probably much less, than 100 feet below the contact between the Brassfield (Silurian), and the Richmond (Ordovician). Previous mapping places this section about 100 feet below the contact (Norris, 1948).

The section from which the samples were obtained was described in a non-detailed fashion. Because most of the shales and limestones of the Richmond are similar to one another in composition, texture, and structure, only the distinction between limestone and shale was made. In describing the section, all units thicker than .02 foot were measured separately.

OUTCROPS OF RICHMOND

OUTCROP WHERE SAMPLES WERE TAKEN

FIG. 1. SHOWING LOCATION OF RICHMOND OUTCROPS



The section is 45.35 feet thick, and composed predominantly of a gray-blue, medium-grained fossiliferous limestone. The shales are greenish gray, very calcareous, thinly bedded, and contain very few megafossils. These shales make up slightly more than 31 percent of the exposed thickness of the section. For results of the measurements, see Table I. It must be noted that measurements involving the top of the section are approximations, made necessary by slumping and concealment by glacial drift. A generalized column appears in figure 2a.

Megafossils occurring in the section include specimens of the brachiopods Hebertella, Leptaena, Plaesiomys, Platystrophia, Rafinesquina, Rhynchotrema capax, and R. dentatum, and representatives of various species of Strophomena, as well as the pelecypods Pterinea, Byssonychia, and Ischyrodonta. Other molluscs such as gastropods and cephalopods are scarce. Solitary corals and many forms of bryozoans are abundant, as are fragments of the trilobite Isotelus.

STRATIGRAPHIC PROBLEMS IN THE RICHMOND

The Upper Ordovician in southwestern Ohio is particularly confusing because of the extreme similarities in lithology between the so-called formations. Many accepted formations are not lithologically distinctive, and were originally described as faunal zones (Cumings,1907; Nickles, 1903). However even the fossil content is not distinctive in many cases because the ranges of species of one zone overlap ranges of species of another zone.

The Liberty, Whitewater, and Elkhorn formations, which are successive stratigraphic units, are not clearly distinguishable

TABLE I

RESULTS OF SECTION MEASUREMENT

ALL VALUES ARE IN FEET, S=SHALE, L=LIMESTONE

0.25 L	0.12 L	0.08 L	0.39 L	0.29 S	0.12 S	0.23 S
0.16 S	0.16 S	0.16 S	0.06 S	0.22 L	0.48 L	0.47 L
9th SAMPLE -1.18 L	0.20 L	0.20 L	0.02 L	0.04 S	0.16 S	0.21 L
4.00 S	0.75S	0.49 S	0.29 S	0.15 L	0.26 L	0.04 S
8th- 0.26 L	0.05 L	0.10 L	0.04 L	0.04 S	0.14 L	0.27 L
2.09 S	0.21 S	0.15 S	0.05 S	0.11 L	0.29 S	0.13 S
0.50 L	0.06 L	0.06 L	0.03 L	0.02 S	0.33 L	0.12 L
2.60 S	1.00 S	0.12 S	0.13 S	0.19 L	0.14 S	0.31 S
7th- 0.46 L	0.04 L	0.10 L	0.06 L	0.02 S	0.15 L	0.16 L
1.71 S	0.13 S	0.08 S	0.08 S	0.25 L	0.17 L	0.30 S
0.53 L	0.13 L	0.29 L	0.12 L	0.04 S	0.20 S	0.25 L
1.01 S	0.12 S	0.10 S	0.03 S	3RD- 0.20 L	0.35 L	1.10 S
0.38 L	0.04 L	0.10 L	0.38 L	0.35 S	0.22 S	0.21 L 1ST SAMPLE
0.19 S	0.33 S	0.16 S	0.10 S	0.30 L	0.23 L	0.63 S
0.55 L	0.11 L	0.04 L	0.29 L	0.11 S	0.68 S	
1.71 S	0.25 S	0.29 S	0.18 S	0.25 L	2ND- 0.37 L	
6th- 0.75 L	5th- 0.54 L	0.08 L	0.04 L	0.04 S	0.02 S	
0.21 S	0.15 S	0.39 S	0.16 S	0.21 L	0.36 L	
0.35 L	0.10 L	0.26 L	0.04 L	0.06 S	0.56 S	
0.25 S	0.14 S	0.04 S	0.15 S	0.08 L	0.30 L	
0.21 L	0.11 L	4th- 0.25 L	0.08 L	0.02 S	0.42 S	
0.11 S	0.55 S	0.04 S	0.19 S	0.20 L	0.20 L	
0.12 L	0.07 L	0.29 L	0.08 L	0.17 S	0.12 S	
0.55 S	0.19 S	0.14 S	0.16 L	0.30 L	0.05 L	

	BELODINA PROFUNDA	DREPANOISTODUS H	DREPANOISTODUS O	DREPANOISTODUS S	OULODUS OREGONIA ULRICHI T	OULODUS OREGONIA ULRICHI Z	OULODUS OREGONIA ULRICHI Eo/E	OULODUS OREGONIA ULRICHI CY	OULODUS OREGONIA ULRICHI OU	OULODUS OREGONIA ULRICHI PR	PANDERODUS GRACILIS C	PANDERODUS GRACILIS G	PLECTODINA FURCATA T	PLECTODINA FURCATA Z	PLECTODINA FURCATA C	PLECTODINA FURCATA CY	PLECTODINA FURCATA OZ	PLECTODINA FURCATA PR	PLECTODINA ROBUSTA T	PLECTODINA ROBUSTA Z	PLECTODINA ROBUSTA Eo/E	PLECTODINA ROBUSTA CY	PLECTODINA ROBUSTA OZ	PLECTODINA ROBUSTA PR	RHIPIDOGNATHUS SYMMETRICA DISCRETA T	RHIPIDOGNATHUS SYMMETRICA DISCRETA B	RHIPIDOGNATHUS SYMMETRICA DISCRETA OB	TOTAL
73SuW-9	—	—	—	—	1	1	1	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	1	1	—	8
73SuW-8	2	1	—	—	5	2	2E 3	1	1	2	—	—	—	—	3	2	15?	—	—	—	—	—	—	—	—	—	—	39
73SuW-7	—	—	—	—	—	1	1	—	—	2	—	—	—	1	2	1	1	1	—	—	—	—	—	—	—	—	—	10
73SuW-6	1	1	—	—	2	3	2	—	—	1	—	—	2	—	5	—	3	1	—	—	1	—	—	—	—	—	—	22
73SuW-5	2	1	—	—	1	—	—	—	—	—	—	—	—	—	5	—	4	1	—	—	1	—	—	—	—	—	—	15
73SuW-4	1	—	—	—	—	1	2	—	1	1	—	—	2	—	1	1	5	2	—	—	—	—	—	—	—	—	—	17
73SuW-3	—	1	—	—	—	2	—	—	—	1	—	—	1	—	3	2	6	4	—	1	1	—	—	—	—	—	—	22
73SuW-2	—	2	—	—	3	1	2	—	1	1	—	—	—	1	2	—	3	1	2	2	3	1	—	—	—	—	—	25
73SuW-1	1	7	1	2	3	1	2E	—	4	—	1	1	—	—	1	—	—	2	1	—	2	—	—	—	—	—	—	29

FIG 2 B CONODONT OCCURRENCE BY SAMPLES H = DREPANODUS HOMOCURVATUS, O = DISTODUS, S = D. SUBERECTUS. T = TRICHONODELLA, Z = ZYGOGNATHUS, Eo = EOLIGONODINA, C = CORDYLODUS CY = CYRTONIODUS, OU = OULODUS, OZ = OZARKODINA, PR = PRIONIODINA, B = BRYANTODINA

TOTAL 187

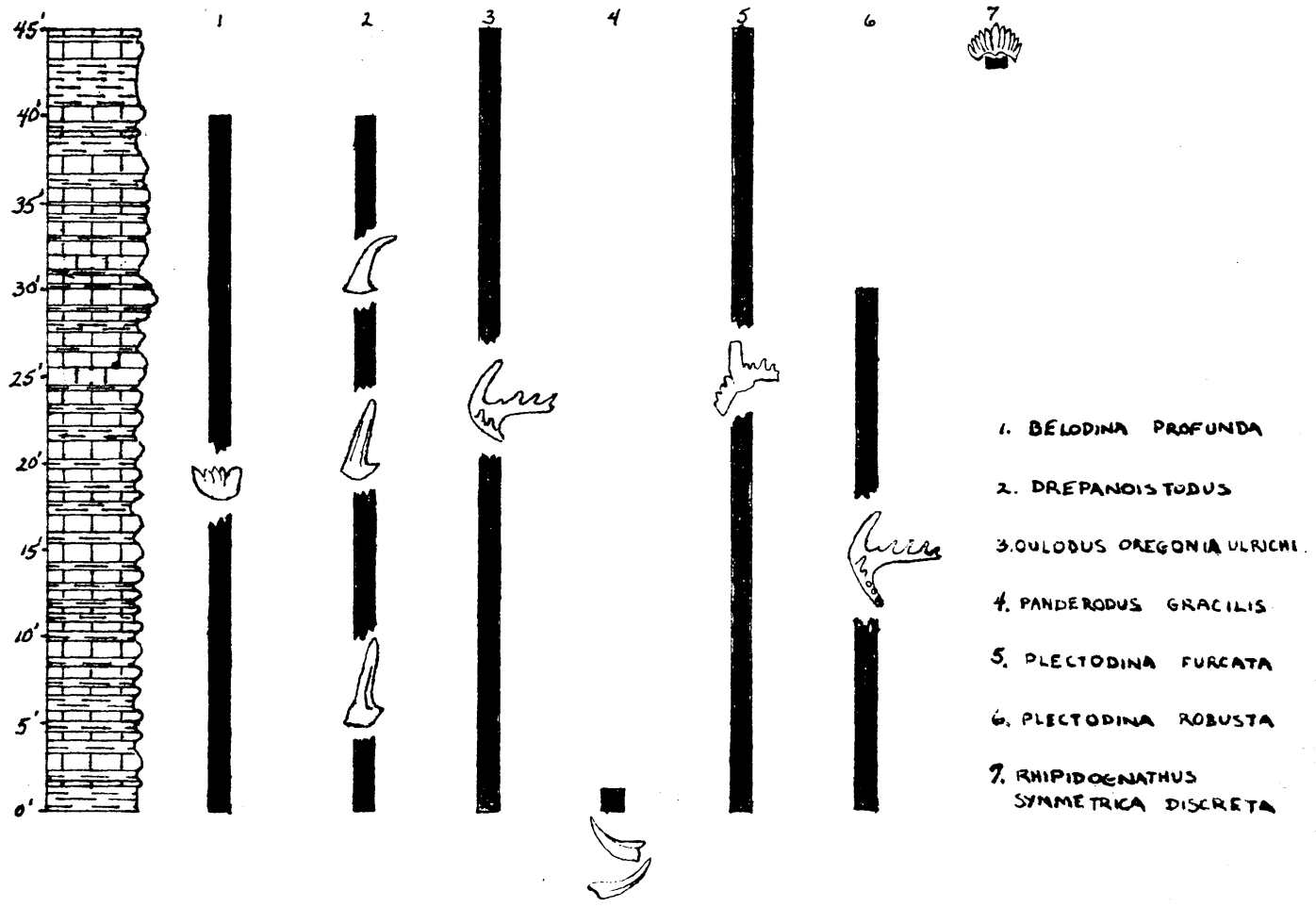
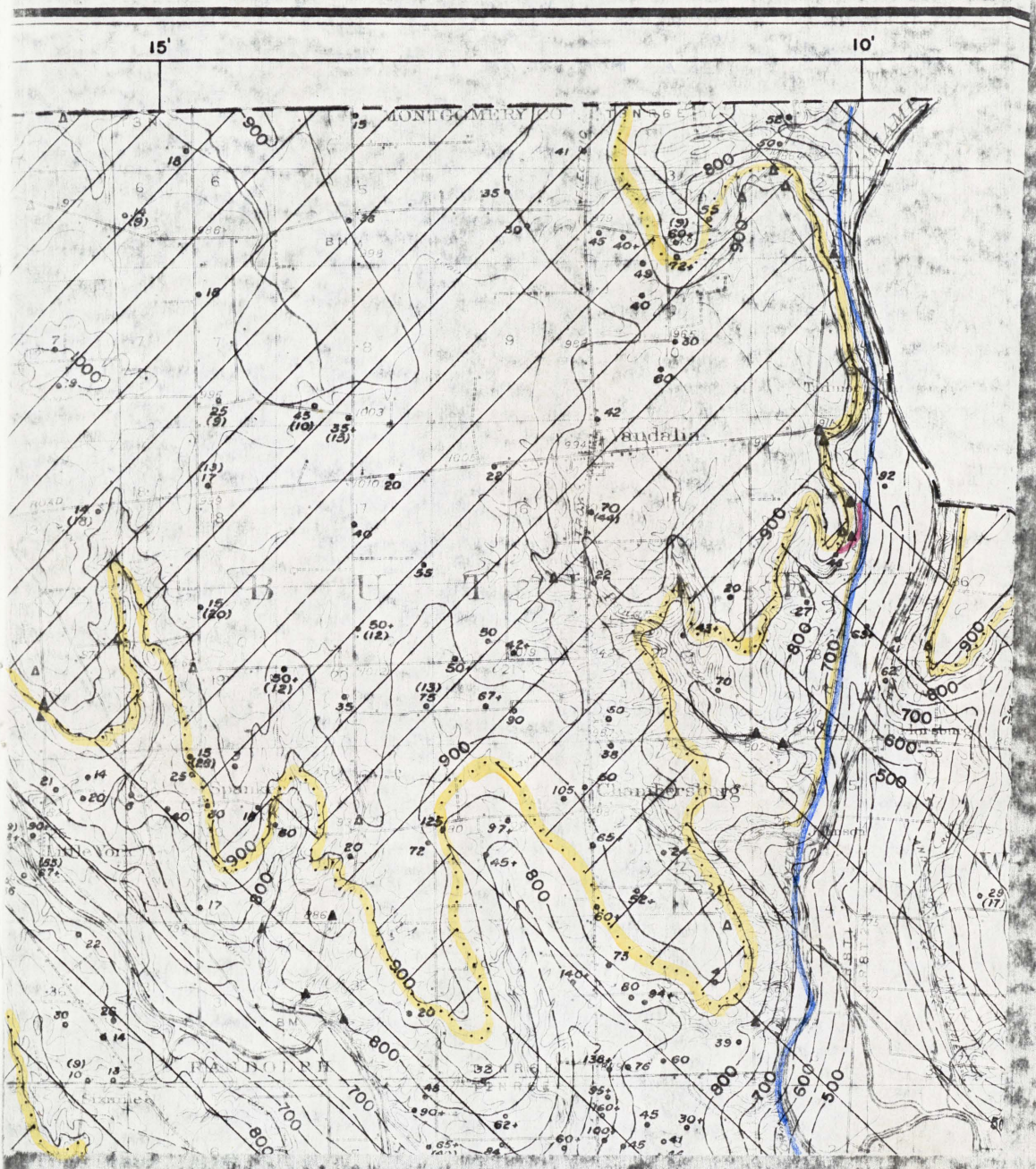


FIG 2 A GENERALIZED STRATIGRAPHIC SECTION AND CONODONT DISTRIBUTION

lithologically, and were described first as faunal units (Cumings, 1907; McClish, 1965; Nickles, 1903). Their thicknesses vary from place to place, and it is often difficult to tell which unit is exposed at a particular place. A study of the conodont species should yield a means of determining one's stratigraphic position rather accurately. The use of conodonts is well suited to this, for the stratigraphic position is determined not by the presence of one particular species (as is the usual case with megafossils), but by the relative abundance of several species. Conodonts are readily obtainable by digestion of limestones. In most cases, megafossils are not accurate indicators when used in a relative abundance fashion, because they are difficult to extract from consolidated rock. Surface counting of fossils provides an approximation of the fossils of a given type within a rock, but by extracting the conodonts from a rock, one is able to determine exactly the number and types of elements contained within a given mass of rock, and therefore by careful comparison with relative abundance logs, one can determine the sample's stratigraphic position. Applications of this sort are now being made in relation to the confusing units of the Richmond.

It has also been noted that at the Brassfield-Richmond contact, the Richmondian lithic type varies from place to place, suggesting a regional unconformity. McClish (1965) has suggested that this may be just as adequately explained by means of facies changes, in light of the intertounging relationships in the Richmond. The author has noted that the Brassfield-Richmond contact dips rather abruptly in some areas, notably along Cassel Road, where it meets the Baltimore and Ohio Railway just east of Vandalia (Fig. 3). Here the

FIG. 3 CONTACT OF BRASSFIELD AND RICHMOND DROPS ABOUT 70 FEET WITHIN A DISTANCE OF 200 YARDS, SOUTH OF THE BALTIMORE & OHIO RAILWAY AND ITS CONTACT WITH CASSEL ROAD.



SILURIAN
(undifferentiated)

ORDOVICIAN
(undifferentiated)

BALTIMORE & OHIO R. R.

CASSEL ROAD

BRASSFIELD-RICHMOND CONTACT

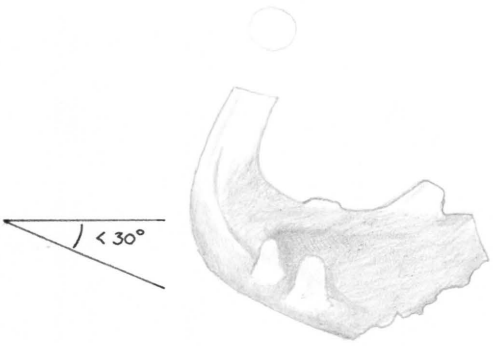
OBSERVED SILURIAN-ORDOVICIAN CONTACT

difference amounts to approximately 70 feet. This may represent a channel or other erosional feature. The use of conodonts could determine whether the change of lithic types is facies controlled, or rather a feature of an unconformity, or more likely a combination of both. Previous work has been of the reconaissance type, and detailed maps of the contact in Montgomery County are lacking.

CONODONT BIOSTRATIGRAPHY OF THE SECTION

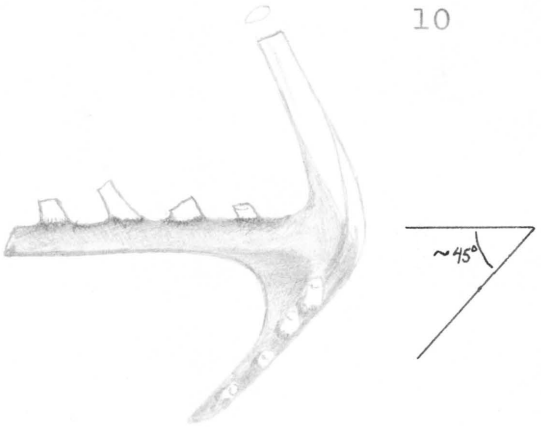
Condonts representing seven multielement species were collected from residues of the nine samples prepared. These species are Belodina profunda (Branson & Mehl), Drepanoistodus (formerly Drepanodus) suberectus (Branson & Mehl), Oulodus oregonia ulrichi (Stone & Furnish), Panderodus gracilis (Branson & Mehl), Plectodina furcata (Hinde), P. robusta (Branson, Mehl, & Branson), and Rhipidognathus symmetrica discreta (Bergström & Sweet).

A diagram showing the number of conodont elements recovered from each sample is seen in Fig. 2b. The stratigraphic distribution of the conodonts is shown alongside the stratigraphic column in Fig. 2a. Specimens of Belodina profunda are present to a point approximately five feet from the top of the section, as were elements of Drepanoistodus, represented by the form species Drepanodus homocurvatus, D. suberectus, and Oistodus inclinatus. The multielement species Oulodus oregonia ulrichi (Stone & Furnish), identified by the form species Eoligonodina ulrichi (Stone & Furnish) (Plate I, A & B) extends throughout the entire section. Conversely, Panderodus gracilis (Branson & Mehl) extends to a level only about one foot above the base of the section. Plectodina furcata (Hinde), identified by



EOLIGONODINA ULRICHI (STONE + FURNISH), OF THE MULTI-ELEMENT SPECIES OULODUS OREGONIA ULRICHI

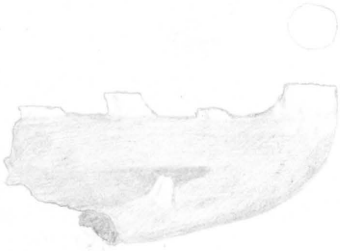
A



EOLIGONODINA ROBUSTA OF THE MULTI-ELEMENT SPECIES PLECTODINA ROBUSTA SHOWING CHARACTERISTIC DISTRIBUTION OF WHITE MATTER

D

B



EOLIGONODINA ULRICHI
ANOTHER SPECIMEN REPRESENTING OULODUS OREGONIA ULRICHI, SHOWING LESSENING OF ANGLE OF ANTERO LATERAL PROCESS WITH POSTERIOR PROCESS (SEE ABOVE).

B

E

OZARKODINA LIKE ELEMENT OF RHIPIDOGNATHUS SYMMETRICA DISCRETA WITH SHALLOW BASAL EXCAVATION AND AND WELL SEPARATED DENTICLES

E

C

PRIONIODINA FURCATA, AN ELEMENT OF THE MULTI-ELEMENT SPECIES PLECTODINA FURCATA

F

BRYANTODINA LIKE ELEMENT OF RHIPIDOGNATHUS SYMMETRICA DISCRETA

the element Prioniodina furcata (Plate I, C) ranges through the entire section, while Plectodina robusta (Branson, Mehl, & Branson) (identified by Eoligonodina robusta, Plate I, D) disappears about 15 feet below the top of the section. Rhipidognathus symmetrica discreta appears only in the uppermost foot of the section and is represented by only two elements in the writer's collection. One of these is Ozarkodina-like, the other is similar to Bryantodina (Plate I, E & F).

In figure 2b, it can be seen that no Phragmodus undatus elements were collected. Since P. undatus dominates Upper Ordovician conodont faunas in eastern North America, up to slightly below the Whitewater Formation in southwestern Ohio (McClish, 1965), it must be assumed that the section described in this report is contained within the Whitewater Formation which extends to the Silurian contact. It should be noted also that the uppermost sample from the section yielded elements of Rhipidognathus, which becomes dominant in the strata of the upper Whitewater Formation (Seddon & Sweet, 1971). This indicates that the section lies between the point at which Phragmodus is no longer present and the point at which Rhipidognathus begins to increase in abundance. Comparison with relative abundance logs for Phragmodus and Rhipidognathus shows the section to be approximately 50 feet below the Brassfield-Richmond contact (Seddon & Sweet, 1971).

CONCLUSION

Maps resulting from previous reconaissance of Montgomery County have shown the Ordovician-Silurian contact to be as much as 120

feet above the outcrop in question. The writer decided a distance of about 30 feet was more accurate, after working at several outcrops in the area and tracing the Brassfield-Richmond contact as well as possible through glacial drift.

The presence of the conodonts found in the section has verified the author's belief that the section was actually much higher stratigraphically than it had been mapped (although the estimate of 30 feet was incorrect). Glacial drift conceals almost all of the bedrock in the area, the outcrop's position relative to the Brassfield-Richmond contact is difficult to determine accurately, and the contact fluctuates in altitude from place to place. Nevertheless, interpretation of a very small number of conodonts gave a good approximation of the outcrop's stratigraphic position.

By easily obtaining and preparing samples from widely separated outcrops whose relationships to one another are dubious, an accurate representation of their stratigraphic positions can be obtained, and correlation of the outcrops can proceed.

It is not being suggested that conodonts be used as the only tool in mapping, but where where the stratigraphic level is in doubt and lithologies are not distinctive, conodonts represent the best and most accurate means available.

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